

ORIGINAL ARTICLE

Species of the genus *Otacilia* from Hainan Island, China (Araneae: Phrurolithidae)

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Abstract Five spider species of the genus *Otacilia* Thorell, 1897 from Hainan Island are reported, including two species described as new to science, *O. biarclata* **sp. nov.** and *O. florifera* **sp. nov.** and three species reported, *O. bawangling* Fu, Zhang & Zhu, 2010, *O. jianfengling* Fu, Zhang & Zhu, 2010, and *O. limushan* Fu, Zhang & Zhu, 2010. The male of *O. limushan* is reported here for the first time. Morphological illustrations and descriptions of new species and *O. limushan* are presented, and photos of all species are provided.

Key words spider, taxonomy, *Otacilia*, China.

1 Introduction

Hainan Island, the southernmost province of China, located in the South China Sea, varies from 18°10'N to 20°10'N and 108°37'E to 111°03'E, and separated from Guangdong's Leizhou Peninsula to the north by Qiongzhou Strait. It has the excellent natural conditions, which is the home to many rare animals and plants (Fu, Zhang & Zhu, 2010). The present paper deals with the spider species of the genus *Otacilia* from Hainan.

Otacilia Thorell, 1897, a paraphyletic taxon of Phrurolithidae (Jäger & Wunderlich, 2012), includes 22 species in China (42 spp. worldwide) (World Spider Catalog, 2015), and wide distributed from East to Southeast Asia. To date, some phrurolithids have been reported from Hainan Island, three *Otacilia* species were described: *O. bawangling* Fu, Zhang & Zhu, 2010, *O. jianfengling* Fu, Zhang & Zhu, 2010 and *O. limushan* Fu, Zhang & Zhu, 2010.

In this paper, two new species are reported under the name of *O. biarclata* **sp. nov.** and *O. florifera* **sp. nov.**, and the male of *O. limushan* is reported for the first time. Morphological illustrations and descriptions of new species and *O. limushan* are presented, and photos of all species are provided.

2 Materials and methods

The terminology follows Hu & Zhang (2011) and Jäger & Wunderlich (2012).

All specimens are preserved in 75% alcohol. Epigynes were removed and cleared in a warm solution of 10% potassium hydroxide, transferred to alcohol and temporarily mounted for drawing. The specimens are deposited in the Museum of Hebei University, Baoding, China (MHBU).

All measurements given in the text are in millimeters (mm). Carapace length was measured from the anterior margin

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to the rear margin of the carapace medially. Eye sizes were measured as the maximum diameter in dorsal or frontal view. Leg measurements are shown as total length (femur, patella, tibia, metatarsus, tarsus). Total length is the sum of the carapace and abdomen lengths, regardless of the petiolus.

Drawing and measuring were made under a Leica M205A stereomicroscope equipped with an Abbe drawing device. Photographs were taken using a Leica M205A stereomicroscope equipped with a DFC450 CCD.

The following abbreviations are used: AER, anterior eye row; ALE, anterior lateral eyes; AME, anterior median eyes; BU, bursae; CD, copulatory duct; CO, copulatory openings; E, embolus; FA, femoral apophysis; FD, fertilization ducts; MOA, median ocular area; MP, median plate; PER, posterior eye row; PLE, posterior lateral eyes; PME, posterior median eyes; PMS, posterior median spinnerets; RTA, retrolateral tibial apophysis; SD, sperm duct; SP, spermathecae; TA, tegular apophysis.

3 Taxonomy

Phrurolithidae Banks, 1892

Otacilia Thorell, 1897

Otacilia biarclata sp. nov. (Figs 1–20)

Material examined. Holotype ♂, China, Hainan Province, Ledong County, Mt. Jianfengling, Main Peak (18°43'47"N, 108°52'21"E), 31 January 2015, Li-Na Fu leg. Paratypes: 7♂, 2♀, Chi Jin, Bao-Shi Zhang leg., other data as holotype.

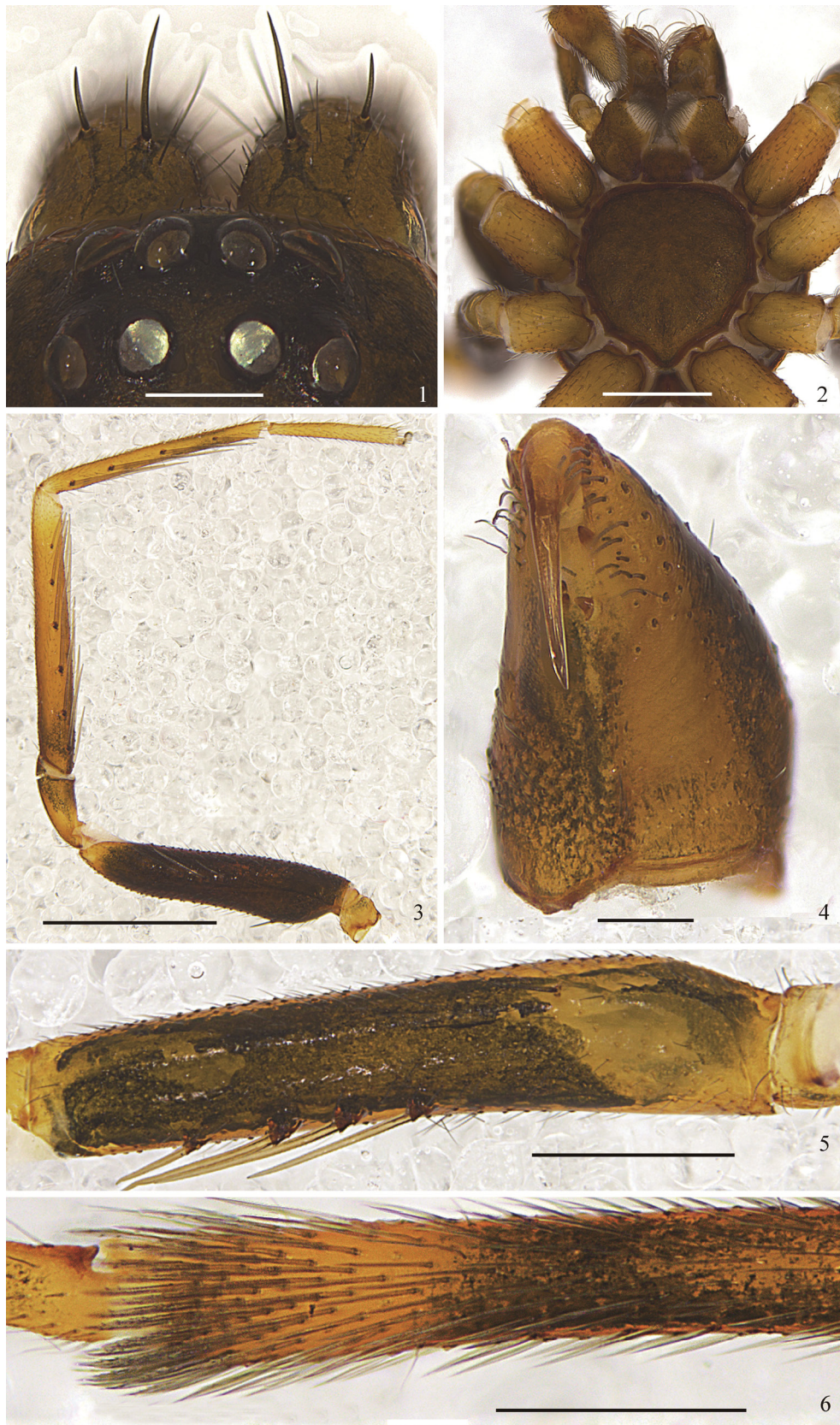
Etmology. The specific name comes from the Latin word '*arc*', combined with the prefix '*bi-*', referring to the two arc-shaped copulatory ducts; adjective.

Diagnosis. Among the congeners, the new species is characteristic in having two arc-shaped copulatory ducts; and long sickle-shaped embolus. It resembles *O. sinifera* Deeleman-Reinhold, 2001 in having similar copulatory ducts, but can be distinguished by: 1) longer and thicker embolus; 2) copulatory openings anteriorly; 3) wooden-stick-shaped bursae. The female of the new species can be separated from *O. limushan*, *O. jianfengling* and *O. bawangling* by: 1) absence of median plate; 2) smaller copulatory openings; 3) wooden-stick-shaped bursae.

Description. Male (Fig. 7). Total length 3.05–3.25 ($n=8$). Holotype body 3.12 long; carapace 1.43 long, 1.23 wide; abdomen 1.58 long, 0.98 wide. Carapace dark brown, oval, abruptly narrow anteriorly, medium brown; thoracic part slightly higher than the cephalic part; fovea longitudinal, distinct. In dorsal view, AER slightly recurved, PER slightly wider than AER and almost straight. Diameter of eyes: AME 0.07, ALE 0.09, PME 0.08, PLE 0.06. Interdistances of eyes: AME–AME 0.04, AME–ALE 0.02, PME–PME 0.07, PME–PLE 0.04. MOA 0.24 long, front 0.20 wide, back 0.23 wide. Clypeus 0.10 high. Chelicerae with two strong anterior bristles (Fig. 1); cheliceral promargin with two well-separated teeth and retromargin with two clustered denticles (Fig. 4). Labium slightly wider than long (Fig. 2). Legs light brown. Leg measurements: leg I 5.52 (1.59, 0.37, 1.56, 1.26, 0.74), II 4.04 (1.12, 0.31, 1.01, 0.90, 0.70), III 3.75 (1.16, 0.25, 0.91, 0.76, 0.67), IV 5.99 (1.61, 0.43, 1.45, 1.51, 0.99). Leg formula: 4123. Femora I–IV basally with one dorsal spine. Femur I with four prolateral spines (Fig. 5) and femur II without prolateral spine; tibia I with six or seven proventral spines and seven retroventral spines, tibia II with six proventral spines and five retroventral spines; metatarsus I with four pairs of ventral spines, metatarsus II with four proventral spines and three retroventral spines; metatarsi III and IV with distal preening brush (Fig. 6). Abdomen dark brown; anterior half without a dorsal scutum; posterior half dark brown, with a white spot terminally.

Palp (Figs 9–12, 15–18). Palp with a thick, posteriorly extending RTA, consisting of a broad base and a hook-shaped tip; femur with an distal apophysis and a retrolateral concavity; distal cymbium ventrally with several hairs; tegulum convex, TA short and small; embolus strong, hook-shaped, slightly sharp apically.

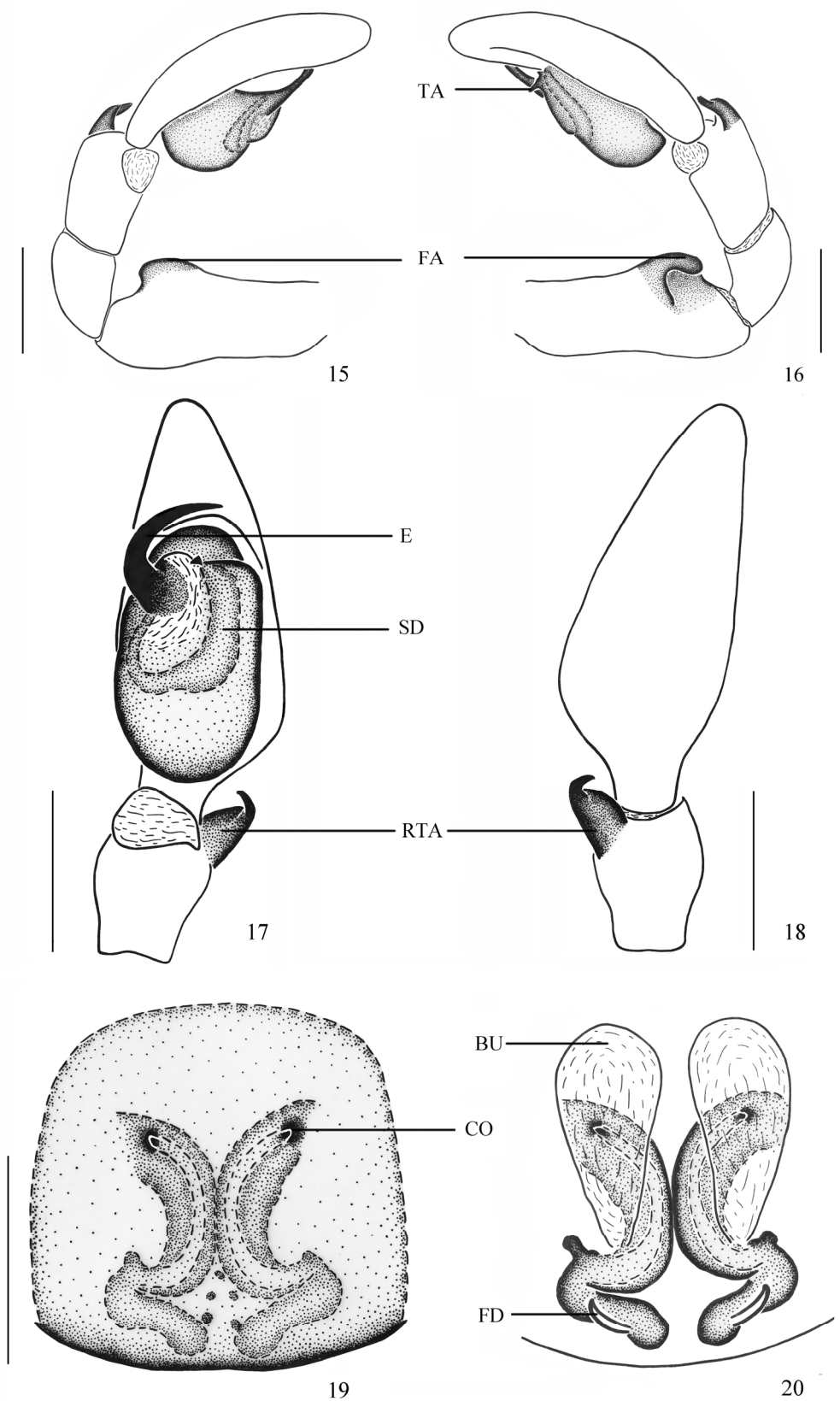
Female (Fig. 8). Total length 3.45–4.03 ($n=2$). One paratype body 4.03 long; carapace 1.84 long, 1.61 wide; abdomen 2.24 long, 1.41 wide. Carapace light brown, oval, abruptly narrow anteriorly. Diameter of eyes: AME 0.08, ALE 0.07, PME 0.09, PLE 0.08. Eye interdistances: AME–AME 0.05, AME–ALE 0.04, PME–PME 0.09, PME–PLE 0.06. MOA 0.28 long, front 0.21 wide, back 0.29 wide. Clypeus 0.09 high. Chelicerae light brown. Labium and gnathocoxae brown. Legs and palps yellowish brown. Leg measurements: I 6.22 (1.52, 0.51, 1.86, 1.46, 0.87), II 5.26 (1.20, 0.54, 1.42, 1.21,



Figs 1–6. *Otacilia biarclata* **sp. nov.** 1. Eyes and chelicerae, ♂, dorsal view. 2. Endites, labium and sternum, ♂, ventral view. 3. Left leg I, ♂, lateral view. 4. Right chelicerae, ♂, lateral view. 5. Left femur I, ♂, prolateral view. 6. Left metatarsus III, lateral view. Scale bars: 3 = 1.00 mm; 2, 5 = 0.50 mm; 1, 6 = 0.20 mm; 4 = 0.10 mm.



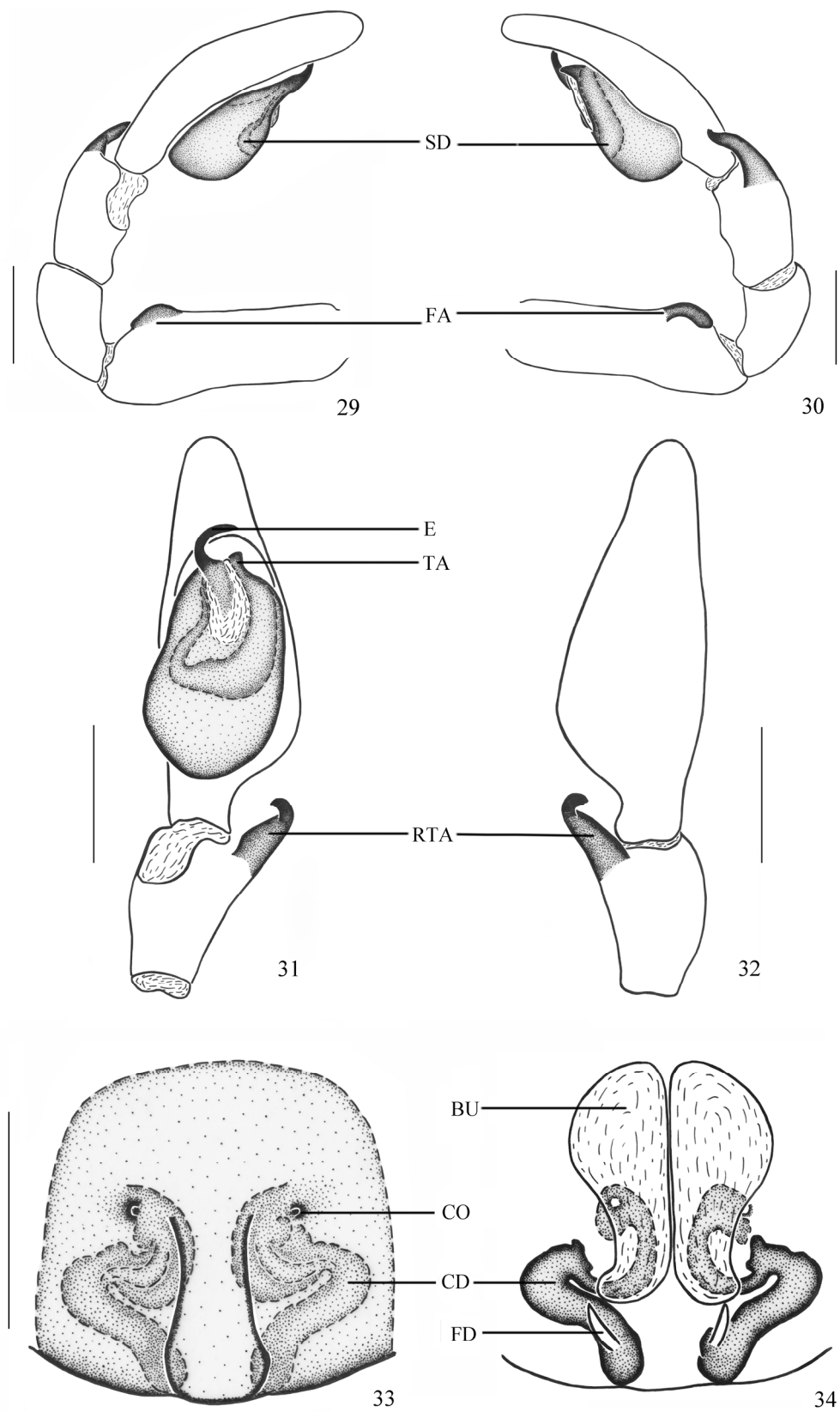
Figs 7–14. *Otacilia biarclata* **sp. nov.** 7. Body, ♂, dorsal view. 8. Body, ♀, dorsal view. 9–12. Left palp, ♂. 9. Dorsal view. 10. Prolateral view. 11. Ventral view. 12. Retrolateral view. 13. Epigyne, ventral view. 14. Vulva, dorsal view. Scale bars: 7–8 = 1.00 mm; 9–14 = 0.20 mm.



Figs 15–20. *Otacilia biareolata* sp. nov. 15–18. Left palp, ♂. 15. Prolateral view. 16. Retrolateral view. 17. Ventral view. 18. Dorsal view. 19. Epigyne, ventral view. 20. Vulva, dorsal view. Scale bars = 0.25 mm.



Figs 21–28. *Otacilia florifera* **sp. nov.** 21. Body, ♂, dorsal view. 22. Body, ♀, dorsal view. 23–26. Left palp, ♂. 23. Dorsal view. 24. Prolateral view. 25. Ventral view. 26. Retrolateral view. 27. Epigyne, ventral view. 28. Vulva, dorsal view. Scale bars: 21–22 = 1.00 mm; 23–28 = 0.20 mm.



Figs 29–34. *Otacilia florifera* sp. nov. 29–32. Left palp, ♂. 29. Prolateral view. 30. Retrolateral view. 31. Ventral view. 32. Dorsal view. 33. Epigyne, ventral view. 34. Vulva, dorsal view. Scale bars = 0.25 mm.



Figs 35–37. *Otacilia limushan* Fu, Zhang & Zhu, 2010, holotype. 35. Body, ♀, dorsal view. 36. Epigyne, ventral view. 37. Vulva, dorsal view. Scale bars: 35 = 1.00 mm; 36–37 = 0.20 mm.

0.89), III 4.76 (1.15, 0.49, 1.04, 1.25, 0.83), IV 7.27 (1.95, 0.58, 1.76, 1.87, 1.11). Leg formula: 4123. Femora I–IV basally with one dorsal spine. Femur I with four prolateral spines and femur II with two prolateral spines; tibia I with seven pairs of ventral spines, tibia II with seven proventral spines and six retroventral spines; metatarsi I and II with the same spination as male. Abdomen without a narrow dorsal scutum. Other characters as in male.

Epigyne (Figs 13–14, 19–20). Copulatory openings small, oval, anteriorly (Figs 13, 19). Vulva anteriorly with a pair of large transparent wooden-stick-shaped bursae, posteriorly with a pair of thick, closely situated spermathecae; copulatory duct relatively long; glandular appendage much shorter than fertilization duct.

Distribution. China (Hainan).

***Otacilia florifera* sp. nov.** (Figs 21–34)

Material examined. Holotype ♂, China, Hainan Province, Lingshui County, Mt. Diaoluo (18°40'13"N, 109°53'44"E), 28 January 2015, Li-Na Fu leg. Paratypes: 2♂, 14♀, same data as holotype; 8♂, 28♀, Wuzhishan City, Mt. Wuzhi (18°51'59"N, 109°40'46"E), 26 January 2015, Li-Na Fu, Chi Jin leg.

Etymology. The specific name derived from Latin word '*florifer*', refers to the abdomen dorsum having some white flowery markings; adjective.

Diagnosis. The new species resembles *O. jianfengling*, both having a similar RTA, but can be distinguished from the latter by: 1) smaller and shorter tegular apophysis; 2) smaller copulatory openings; 3) narrower median plate. The female of this new species also resembles *O. limushan* in having similar bursae, but can be separated from the latter by the smaller copulatory openings and narrower median plate.

Description. Male (Fig. 21). Total length 3.19–3.38 ($n=3$). Holotype body 3.38 long; carapace 1.52 long, 1.31 wide; abdomen 1.81 long, 1.01 wide. Carapace yellow and black, oval, abruptly narrow anteriorly, medium black; thoracic part slightly higher than the cephalic part; fovea longitudinal, distinct. Diameter of eyes: AME 0.10, ALE 0.08, PME 0.07, PLE 0.08. Eye interdistances: AME–AME 0.05, AME–ALE 0.01, PME–PME 0.07, PME–PLE 0.04. MOA 0.28 long, front 0.26 wide, back 0.25 wide. Clypeus 0.11 high. Chelicerae light brown, with two bristles anteriorly; promargin of cheliceral furrow with three well-separated teeth and retromargin with five teeth near to each other. Labium and gnathocoxae brown. Legs and palps yellow and black. Leg measurements: I 7.98 (1.97, 0.43, 2.48, 1.98, 1.12); II 7.11 (1.78, 0.49, 2.47, 1.38, 0.99); III 5.14 (1.38, 0.35, 1.26, 1.41, 0.74); IV 8.48 (2.35, 0.44, 2.21, 2.35, 1.13). Leg formula: 4123. Femora I–IV with only one dorsal spine. Femur I with four prolateral spines and femur II with three prolateral spines; tibia I with eight pairs ventral spines, tibia II with seven pairs of ventral spines; metatarsus I with four pairs of ventral spines, metatarsus II with four proventral spines and three retroventral spines. Abdomen dark with white, with several light blackish chevron-like stripes posteriorly.

Palp (Figs 23–26, 29–32). Femoral apophysis located ventrally. RTA broad, bird-head-shaped. Tegular apophysis small, short, hilt-shaped. Embolus thin and curved, hook-shaped.

Female (Fig. 22). Total length 3.69–4.82 ($n=11$). One paratype: body 4.46 long; carapace 1.72 long, 1.42 wide; abdomen 2.63 long, 1.58 wide. Carapace brown and black, abruptly narrow anteriorly; fovea longitudinal. Diameter of eyes: AME 0.09, ALE 0.08, PME 0.08, PLE 0.09. Eye interdistances: AME–AME 0.05, AME–ALE 0.02, PME–PME 0.09, PME–PLE 0.04. MOA 0.26 long, front 0.25 wide, back 0.27 wide. Clypeus 0.11 high. Leg measurements: I 7.11 (1.83, 0.41, 2.30, 1.63, 0.94); II 6.33 (1.69, 0.38, 1.99, 1.43, 0.84); III 5.32 (1.38, 0.31, 1.38, 1.46, 0.79); IV 8.11 (2.33, 0.42, 1.96, 2.39, 1.01). Leg formula: 4123. Femora I–IV with one dorsal spine. Femur I with four to six prolateral spines and femur II with three prolateral spines; tibia I with seven or eight proventral spines and 7 pairs of retroventral spines, tibia II with eight pairs of ventral spines; metatarsus I with six proventral spines and five retroventral spines, metatarsus II with four proventral spines and three retroventral spines. Abdomen white and black. Other characters as in male.

Epigyne (Figs 27–28, 33–34). Median plate extending not parallelly, vase-like. Copulatory openings small, situated medially on epigynal plate. Vulva anteriorly with a pair of large, transparent kidney-shaped bursae, posteriorly with a pair of spermathecae connecting with strongly curved copulatory ducts; glandular appendage much shorter than fertilization duct.

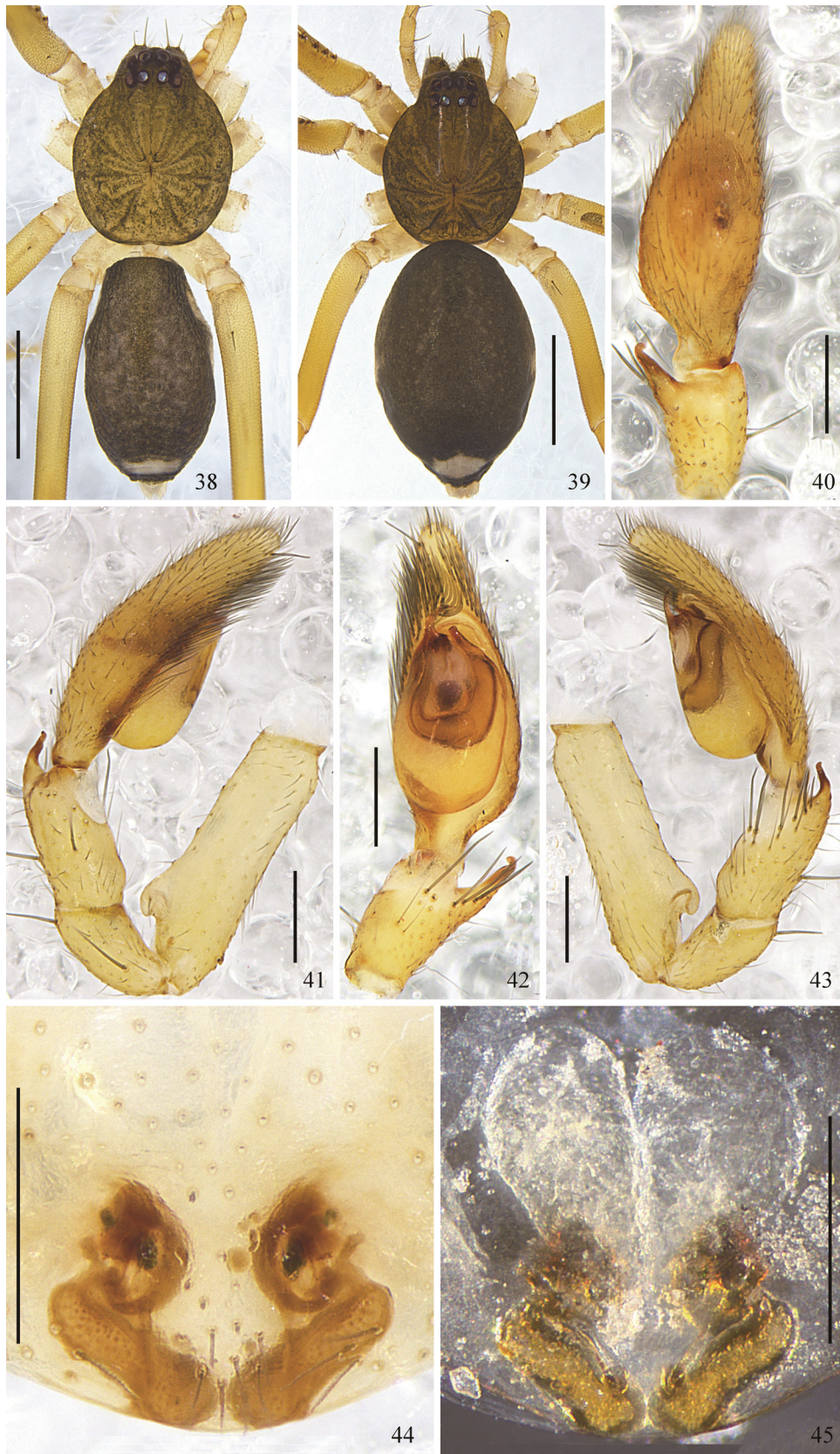
Distribution. China (Hainan).

***Otacilia limushan* Fu, Zhang & Zhu, 2010** (Figs 35–51)

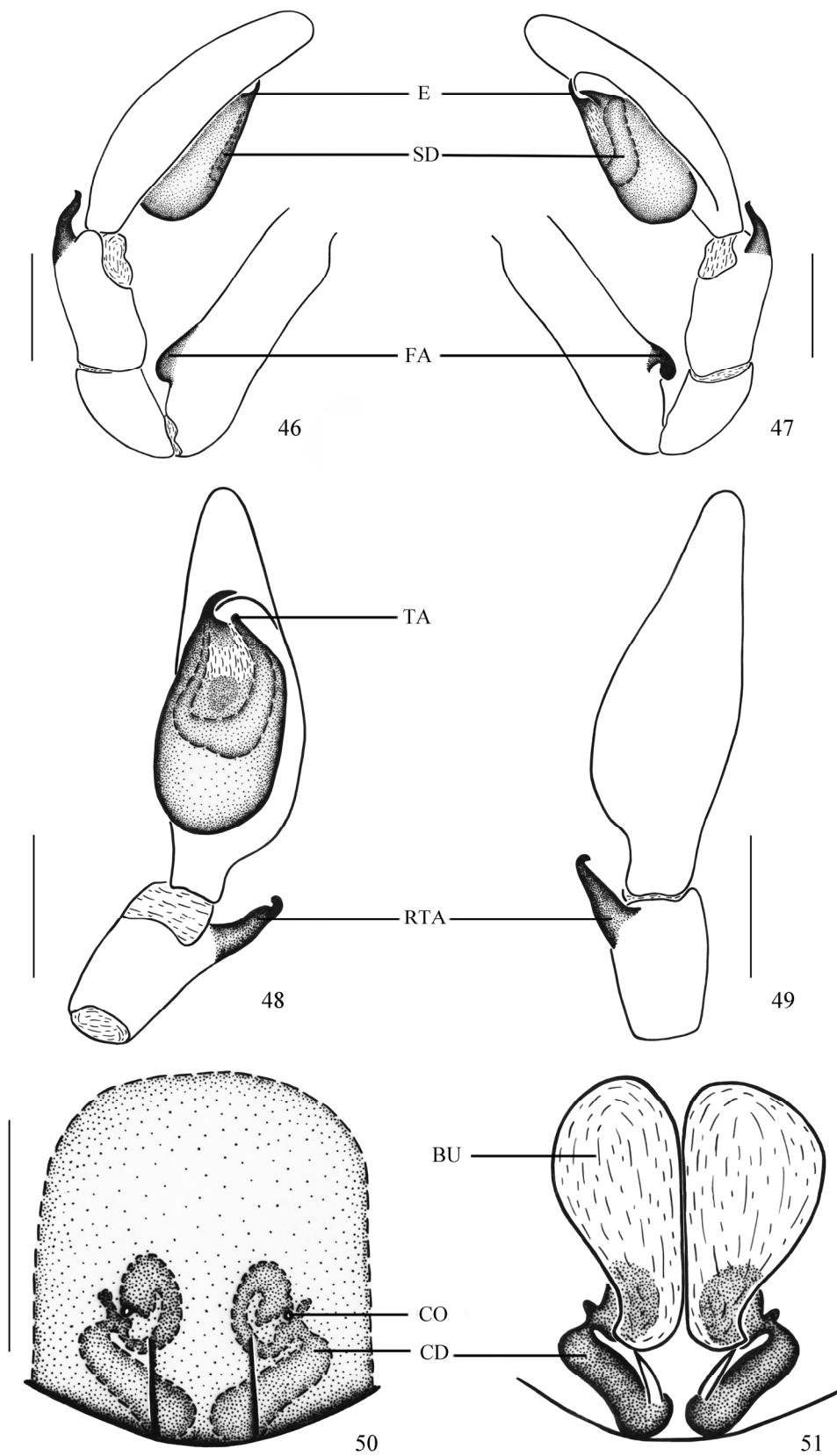
Otacilia limushan Fu, Zhang & Zhu, 2010: 648, f. 4A–C.

Material Examined. Holotype ♀, China, Hainan Province, Qiongzong County, Mt. Limu (19.3°N, 109.1°E), 18 August 2007, Feng Zhang leg. Other materials. China, Hainan Province, Qiongzong County, Mt. Limu, Main Peak (19°10'38"N, 109°44'54"E), 5♂, 8♀, 21 January 2015, Li-Na Fu, Chi Jin leg.; Mt. Limu (19°10'14"N, 109°44'57"E), 5♂, 5♀, 23 January 2015, Li-Na Fu, Bao-Shi Zhang leg.; Limushan Resort (19°10'37"N, 109°44'52"E), 3♀, 20 January 2015, Li-Na Fu leg.

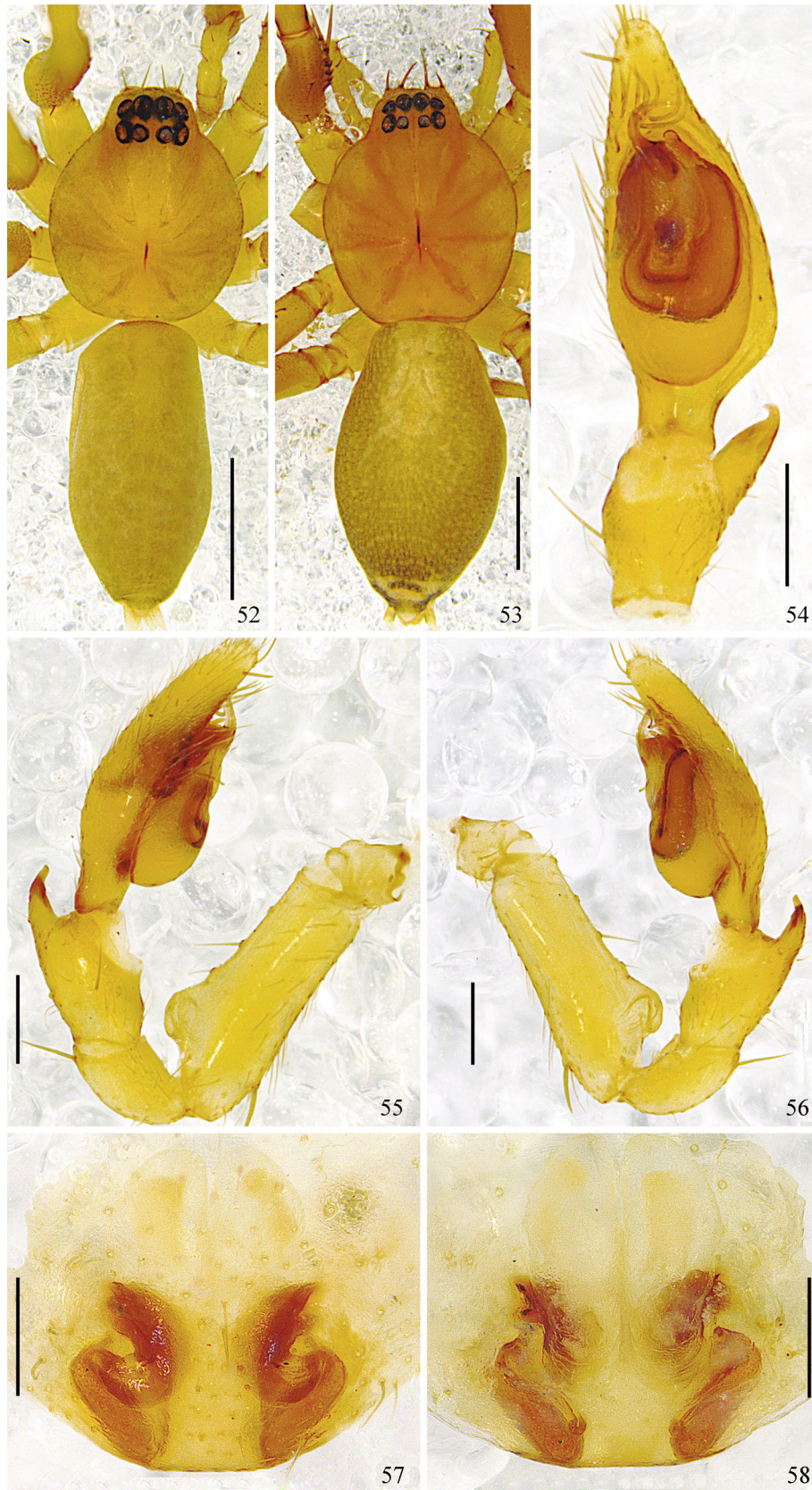
Diagnosis. The male of *O. limushan* resembles *O. jianfengling* in having similar median plate, but the male can be distinguished from it by: 1) shorter and thinner embolus; 2) hilt-like tegular apophysis; 3) thinner RTA; 4) smaller FA. This new species also resembles *O. florifera* sp. nov. in having a similar RTA, but can be separated from the latter by: 1) thicker and straight copulatory ducts, 2) broader median plate, 3) thinner RTA, and 4) no body stripes.



Figs 38–45. *Otacilia limushan* Fu, Zhang & Zhu, 2010. 38. Body, ♂, dorsal view. 39. Body, ♀, dorsal view. 40–43. Left palp, ♂. 40. Dorsal view. 41. Prolateral view. 42. Ventral view. 43. Retrolateral view. 44. Epigyne, ventral view. 45. Vulva, dorsal view. Scale bars: 38–39 = 1.00 mm; 40–45 = 0.20 mm.



Figs 46–51. *Otacilia limushan* Fu, Zhang & Zhu, 2010. 46–49. Left palp, ♂. 46. Prolateral view. 47. Retrolateral view. 48. Ventral view. 49. Dorsal view. 50. Epigyne, ventral view. 51. Vulva, dorsal view. Scale bars = 0.25 mm.



Figs 52–58. *Otacilia jianfengling* Fu, Zhang & Zhu, 2010, holotype (♂) or paratype (♀). 52. Body, ♂, dorsal view. 53. Body, ♀, dorsal view. 54–56. Left palp, ♂. 54. Ventral view. 55. Prolateral view. 56. Retrolateral view. 57. Epigyne, ventral view. 58. Vulva, dorsal view. Scale bars: 52–53 = 1.00 mm; 54–58 = 0.20 mm.

Description. Male (Fig. 38). Total length 2.97–3.49 ($n=6$). One male from Mt. Limu, Main Peak, body 3.49 long; carapace 1.55 long, 1.26 wide; abdomen 1.84 long, 0.99 wide. Carapace yellowish grey, oval, abruptly narrow anteriorly, medium grey; thoracic part slightly higher than the cephalic part; fovea longitudinal, distinct. Diameter of eyes: AME 0.11, ALE 0.07, PME 0.08, PLE 0.07. Eye interdistances: AME–AME 0.05, AME–ALE 0.02, PME–PME 0.08, PME–PLE 0.04. MOA 0.26 long, front 0.25 wide, back 0.25 wide. Clypeus 0.09 high. Chelicerae light brown, with two bristles anteriorly; promargin of cheliceral furrow with three well-separated teeth and retromargin with five teeth near to each other. Labium and gnathocoxae brown. Legs and palps light yellowish. Leg measurements: I 8.34 (2.07, 0.34, 2.67, 1.95, 1.31); II 6.30 (1.63, 0.43, 1.74, 1.52, 0.98); III 5.23 (1.40, 0.39, 1.16, 1.43, 0.85); IV 8.49 (2.24, 0.47, 2.03, 2.46, 1.29). Leg formula: 4123. Femora I–IV with only one dorsal spine. Femur I with four prolateral spines and femur II with three prolateral spines; tibia I with nine pairs of ventral spines, tibia II with seven pairs of ventral spines; metatarsus I with four pairs of ventral spines, metatarsus II with four proventral spines and three retroventral spines. Abdomen dark grey, with a piece of white spot terminally.

Palp (Figs 40–43, 46–49). Femoral apophysis located ventrally. RTA thin; tibia with a row of long spines distally. Tegular apophysis short, hilt-like. Embolus thin and curved, sickle-shaped.

Female (Figs 35, 39). Total length 3.60–4.06 ($n=6$). Holotype body 3.64 long; carapace 1.62 long, 1.40 wide; abdomen 2.02 long, 1.17 wide. Carapace dark brown, abruptly narrow anteriorly; fovea longitudinal. Diameter of eyes: AME 0.09, ALE 0.09, PME 0.07, PLE 0.08. Eye interdistances: AME–AME 0.12, AME–ALE 0.10, PME–PME 0.13, PME–PLE 0.12. MOA 0.32 long, front 0.24 wide, back 0.26 wide. Clypeus 0.09 high. Leg measurements: I 8.02 (2.30, 0.45, 2.29, 1.80, 1.18); II 5.94 (1.62, 0.36, 1.85, 1.30, 0.81); III 4.32 (1.30, 0.27, 1.04, 0.99, 0.72); IV 8.11 (2.03, 0.54, 2.03, 2.29, 1.22). Leg formula: 4123. Femora I–IV with one dorsal spine. Femur I with five prolateral spines and femur II with three prolateral spines; tibia I with eight pairs of ventral spines, tibia II with eight pairs of ventral spines; metatarsus I with four pairs of ventral spines, metatarsus II with four pairs of ventral spines. Abdomen dark dorsally. Other characters as in male.

Epigyne (Figs 36–37, 44–45, 50–51). The margin of median plate extending parallelly and longitudinally. Copulatory openings small, situated medially on epigyne, located in the shallow concavities anteriorly (Figs 36, 44, 50). Vulva anteriorly with a pair of large, transparent kidney-shaped bursae, posteriorly with a pair of spermathecae connecting with lightly curved copulatory duct, glandular appendage much shorter than fertilization duct.

Distribution. China (Hainan).

Note. *Otacilia limushan* was originally described by Fu, Zhang & Zhu (2010) on the basis of a female holotype collected from Mt. Limu, Hainan Province, China. While examining the *Otacilia* specimens collected from Mt. Limu in 2015, we easily identified the female as *O. limushan* according to the original description, and considered that the male specimen also belongs to the same species because the habitus and the marking are very similar to those of the female. Therefore the male *O. limushan* is reported for the first time.

***Otacilia jianfengling* Fu, Zhang & Zhu, 2010 (Figs 52–58)**

Otacilia jianfengling Fu, Zhang & Zhu, 2010: 641, f. 1A–H, 2A–E.

Material examined. Holotype ♂, paratypes 1♂, 4♀, China, Hainan Province, Ledong County, Mt. Jianfengling (18.61°N, 108.93°E), 9 August 1980, Ming-Sheng Zhu leg. Other materials. China, Hainan Province, Ledong County, Mt. Jianfengling, Tianchi Lake (18°44'25"N, 108°51'44"E), 2♂, 3♀, 31 January 2015, Li-Na Fu leg.; Jianfengling National Forest Park (18°44'27"N, 108°51'36"E), 4♂, 4♀, 1 February 2015, Chi Jin leg.

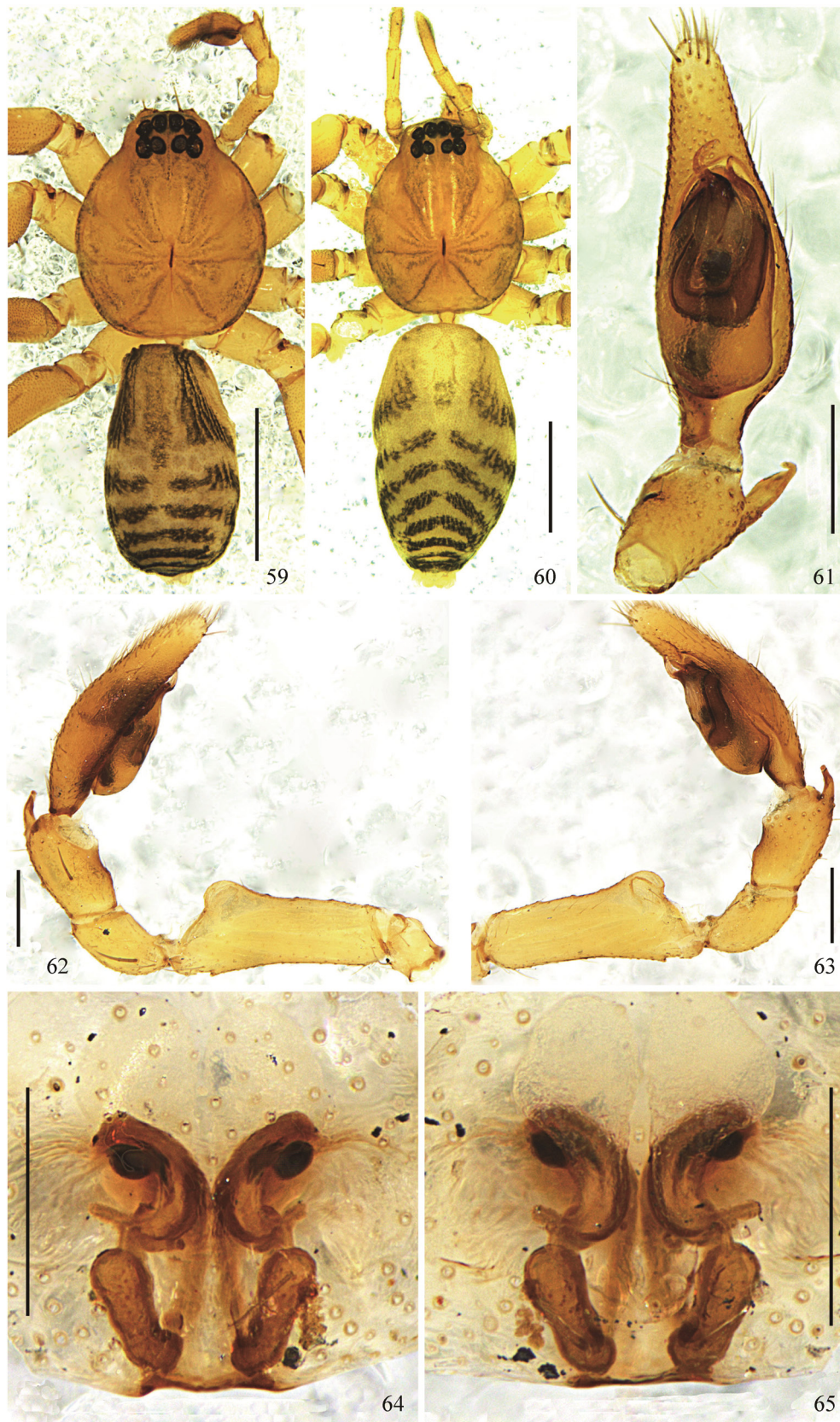
Description. See Fu, Zhang & Zhu (2010). Male (holotype) habitus shown in Fig. 52, male palp in Figs 54–56; female (paratype) habitus in Fig. 53, epigyne and vulva in Figs 57–58.

Distribution. China (Hainan).

***Otacilia bawangling* Fu, Zhang & Zhu, 2010 (Figs 59–65)**

Otacilia bawangling Fu, Zhang & Zhu, 2010: 645, f. 3A–F.

Material examined. Holotype ♂, China, Hainan Province, Changjiang County, Mt. Bawangling (19.3°N, 109.1°E), 7 November 2008, Ming-Sheng Zhu leg. Paratypes: 1♂, 4♀, same data as holotype, Guang-Xin Han, Sheng-Tao Guo and Jian-Yu Guo leg.



Figs 59–65. *Otacilia bawangling* Fu, Zhang & Zhu, 2010, holotype (♂) or paratype (♀). 59. Body, ♂, dorsal view. 60. Body, ♀, dorsal view. 61–63. Left palp, ♂. 61. Ventral view. 62. Prolateral view. 63. Retrolateral view. 64. Epigyne, ventral view. 65. Vulva, dorsal view. Scale bars: 59–60=1.00 mm; 61–65=0.20 mm.

Description. See Fu, Zhang & Zhu (2010). Male (holotype) habitus shown in Fig. 59, male palp in Figs 61–63; female (paratype) habitus in Fig. 60, epigyne and vulva in Figs 64–65.

Distribution. China (Hainan).

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